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PHOTOGRAPH PRINTING DEVICES

CLAIM(S)

1) A photograph printing device, wherein the printing light projected from a light source is radiated to a film after having been diffused by the diffusion plate, and an image recorded on the film is printed on the printing paper via the printing lens, characterized in that fine sharp protrusions are made on said diffusion plate.

2) A photograph printing device, wherein the printing light projected from a light source is radiated to a film after having been diffused by the diffusion plate, and an image recorded on the film is printed on the printing paper via the printing lens, characterized in that said diffusion plate surface on the side of film is made into a convex surface, while making sharp protrusions on said surface on the side of film.

3) A photograph printing device, wherein the printing light projected from a light source is radiated to a film after having been diffused by the diffusion plate, and an image recorded on the film is printed on the printing paper via the printing lens, characterized in that said diffusion plate surface on the side of film is made planar, while making said surface on the side of light source into a convex surface, and sharp protrusions are made on said surface on the side of film.

4) A photograph printing device, wherein the printing light projected from a light source is radiated to a film after having been diffused by the diffusion plate, characterized in that sharp protrusions are densely made on said diffusion plate on the side of film, and the leading edges of the protrusions are flattened.

5) A photograph printing device, wherein the printing light projected from a light source is radiated to a film after having been diffused by the diffusion plate, and an image recorded on the film is printed on the printing paper via the printing lens, characterized in that said diffusion plate surface on the side of light source is formed into a convex surface, while densely making sharp protrusions on the surface on the side of film, and the leading edges of the protrusions are flattened.

DETAILED DESCRIPTION OF THE INVENTION

(Field of Industrial Application)

The present invention pertains to a photograph printing device for printing a recorded image on a film on the printing paper.

(Problems of the Prior Art to Be Addressed)

As a prior art photograph printing device, for example a light-diffusion type photograph printing device shown in Fig. 8 is publicly known. In this photograph printing device, diffusion box 12 is positioned between the negative film 10 and the light source lamp 11. This diffusion box 12 comprises rectangular parallelepiped 21, the inner surface of which is a mirror, diffusion plate 22 on the side of incidence, and diffusion plate 23 on the side of emission which are mounted on its top and bottom,

respectively. For these diffusion plates 22 and 23, glass with a smooth surface or opaque plastic plate is used. After the negative film 10 transferred to the left side in the figure is positioned on the negative mask 16, shutter 15 lit by the light source lamp 11 is opened. Then, the printing light sufficiently diffused by the diffusion box 12 reaches the printing paper 14 via the negative film 10 and printing lens 13, and the image recorded on the negative film 10 is printed on the printing paper 14. The symbol 17 indicates a mask that regulates the printing range on the printing paper 14.

(Problems of the Prior Art to Be Addressed)

With the prior art photograph printing device, the light from the light source is diffused in nearly the same direction. If the light diffusion amount is small at this time, scratches and dust on the negative film 10 will be visible. If the diffusion amount is increased, said problem is eliminated, but there will be a loss in the light amount, reducing the amount of the printing light, which is a problem. The present invention presents a method for minimizing the light loss and making the scratches on the negative film less visible.

(Means to Solve the Problems)

In the present invention, to solve the aforementioned problems, fine protrusions are made on the diffusion plate on the side of the film for diffusing the printing light projected from the light source.

Also, the diffusion plate surface on the side of film may be formed into a

convex surface, while making its other surface on the side of light source planar, and the sharp protrusions may be made on the surface on the side of the film. As an alternative method, the surface of the diffusion plate on the side of the film may be made planar, while making its other surface on the side of the light source into a convex surface, and sharp protrusion can be made on said surface on the side of film. As another alternative method, it is also possible to form the sharp protrusions densely over the surface of the diffusion plate on the side of the film and flatten the leading edges of these protrusions, or to form the diffusion plate surface on the side of the light source into a convex surface and form the sharp protrusions on its other surface on the side of the film, followed by flattening of the leading edges of the protrusions.

(Operation)

By the aforementioned structure, the light from the light source has the distribution of intensity not only in the direction orthogonal to the film surface but also in the oblique incident direction. Accordingly, the light transmitting into the scratches on the film is refracted in many directions, making the scratches less visible on the printing paper.

By making the protrusions on the diffusion plate, the center in the intensity distribution (There is a large center.) can be effectively used for printing by a lens effect.

By this, the use efficiency of the light can be improved. The embodiment

example of the present invention is explained below with reference to the drawings.

(Embodiment Example)

Fig. 1 shows a schematic diagram of the photograph printing device of the present invention. The same symbols are supplied to the same components as those shown in Fig. 8, and explanation is omitted, and shutter 15 is omitted from the figure to avoid the complexity of the drawing. The diffusion box 12 having the diffusion plate 22 on the side of incidence and diffusion plate 30 on the side of emission is positioned above the light source lamp 11. On the surface on the side of film 10 of the diffusion plate 30 on the side of emission, pyramids with a square bottom are arranged with regularity. The density of arranging these protrusions 31 is, for example, approximately 1,000 - 100, 000 protrusions per 1 cm^2. The intensity distribution of the light diffused by the protrusion 31 comes with three peaks (first peak P_1 in the center and two second peaks P_2 on both sides.), as shown in the figure.

In the aforementioned structure, the light projected from the light source 11 is diffused by the diffusion plate 22 on the side of incidence and emitted in diffused state from the diffusion plate 30 on the side of emission after having been mixed in the diffusion box 12. This light is emitted as the diffusion light that has been diffused into the light with three peaks by the protrusion 31.

In the intensity distribution of the light diffused by the protrusion 31, since the diffused light has three peaks shown in the figure, the oblique incident light transmitting into the negative film is as intense as the perpendicular incident light

transmitting to the negative film. Therefore, the light transmitted into the scratches on the film 10 and refracted has many emission angles and is highly intense, so the impact of scratches is not visible on the printing paper 14, and the defect in the printed image is minimized, printing excellent photographs.

Also, as shown in Fig. 4, the diffusion plate 46 on the side of emission may have protrusions on the surface 46a on the side of negative film. By so doing, the intensity distribution of the diffused light diffused by the protrusions, 47, 48, 49, is inclined by the lens effect of the diffusion plate, as shown by 47a, 48a, and 49a. Therefore, by focusing the light of peak P_1 which is highly intense, this light can be effectively used as the printing light. In this case, the diffusion plate surface 46 on the side of emission may be a convex or concave surface to the extent that the diffusion plate 46 on the side of emission works as a convex lens.

In the embodiment example shown in Fig. 5, the diffusion plate 51 on the emission side has planar surface 51a on the side of film and the surface 51b on the side of the light source. By this lens effect also, the light can be effectively used.

In the embodiment examples shown in Fig. 6 and Fig. 7, prismoids with a flat top surface, 57, 62, are densely arranged on the surfaces on the side of film of the diffusion plates on the side of emission, 56, 61, respectively. By this, the planar portion on the surface on the side of film 56a is eliminated, by which the intensity of the emission light advancing perpendicularly to the negative film 10 is supposedly weakened. To prevent this effect, the planar surfaces, 57a, 62a, are formed to

prevent the insufficiency of the light. In the embodiment example shown in Fig. 7, the surface 61b on the side of the light source is used as a convex lens, and by the effect of this convex lens, the light is efficiently used. In this case, the surface on the side of film 61a may be made into a convex or concave surface to the extent that the entire diffusion plate 61 can function as a convex lens.

As for the shape of the protrusions on the surface on the side of emission, it needs not be a pyramid with a square bottom as long as the it has a shape of a leading edge. For example, as shown in Fig. 3, cone shaped protrusions 41 may be made on the surface on the side of film of the diffusion plate 40 on the side of emission. The protrusions 41 may be arrange randomly or with regularity.

It goes without saying that the present invention is applicable likewise to the printing of a positive film.

(Advantage)

As explained above, since fine sharp protrusions are made on the diffusion plate surface on the side of film for diffusing the printing light, the intense light is radiated to the film surface in the oblique direction as well, so the impact on the printing paper by the film scratches can become less visible while minimizing the amount of the light from the light source; thereby allowing to print excellent photographs.

In addition, when the diffusion plate surface on the side of film or light source is made into a convex surface, the light can be effectively used by an effect of the

convex lens. Moreover, the amount of the incident light from the peripheral section into the printing lens is increased by making the light distribution characteristic in the peripheral section different from that in the center, so the ratio of the light amount can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a profile of the photograph printing device with key components.

Fig. 2 shows a configuration of the photograph printing device of Fig. 1.

Fig. 3 shows a schematic diagram of the diffusion plate on the side of emission as another embodiment example.

Fig. 4 shows the side surface of the diffusion plate on the side of emission that has a convex surface on the side of film.

Fig. 5 shows the side surface of the diffusion plate on the side of emission that has a convex surface on the side of light source.

Fig. 6 shows the side surface of the diffusion plate on the side of emission, wherein the leading edges of the protrusions are flattened.

Fig. 7 shows the side surface of the diffusion plate on the side of emission, wherein the leading edges of the protrusions are flattened and the surface on the side of light source has a convex shape.

Fig. 8 shows a schematic diagram of the prior art diffusion light type photographing device.

10. Negative film

11. Light source lamp

13. Printing lens

14. Printing paper

23, 30, 46. Diffusion plate on the side of emission

31, 41, 47 - 49, 57, 62. Protrusions

46a, 51a, 57a, 61a. film side surface

46b, 51b, 61b. The surface of the side of light source

57a, 62a. Flattened surface